



[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No.FAA-2013-1039; Notice No. 25-13-38-SC]

Special Conditions: Bombardier Inc., Models BD-500-1A10 and BD-500-1A11 series airplanes; Flight Envelope Protection: Normal Load Factor (g) Limiting.

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes special conditions for the Bombardier Inc. Models BD-500-1A10 and BD-500-1A11 series airplanes. These airplanes will have a novel or unusual design feature associated with an electronic flight control system that prevents the pilot from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: Send your comments on or before **[insert a date 45 days after date of publication in the Federal Register]**.

ADDRESSES: Send comments identified by docket number FAA-2013-1039 using any of the following methods:

- Federal eRegulations Portal: Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.

- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.

FOR FURTHER INFORMATION CONTACT: Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service,

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SUPPLEMENTARY INFORMATION:

Comments Invited

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive on or before the closing date for comments. We may change these special conditions based on the comments we receive.

Background

On December 10, 2009, Bombardier Inc. applied for a type certificate for their new Models BD-500-1A10 and BD-500-1A11 series airplanes (hereafter collectively referred to as “C-series”). The C-series airplanes are swept-wing monoplanes with a pressurized cabin. They share an identical supplier base and significant common design elements. The fuselage is aluminum alloy material, blended double-bubble fuselage, sized for nominal 5-abreast seating. Each airplane’s powerplant consists of two under wing Pratt and Whitney PW1524G ultra-high bypass, geared turbofan engines. Flight controls are fly-by-wire flight with two passive/uncoupled side sticks. Avionics includes five landscape primary cockpit displays. The dimension of the airplanes encompass a wingspan of 115 feet; a height of 37.75 feet; and a length of 114.75 feet for the Model BD-500-1A10 and a length of 127 feet for the Model BD-500-1A11. Passenger capacity is designated as 110 for the Model BD-500-1A10 and 125 for the Model BD-500-1A11. Maximum takeoff weight is 131,000 pounds for the Model BD-500-1A10

and 144,000 pounds for the Model BD-500-1A11. Maximum takeoff thrust is 21,000 pounds for the Model BD-500-1A10 and 23,300 pounds for the Model BD-500-1A11. Range is 3,394 miles (5,463 kilometers) for both models of airplanes. Maximum operating altitude is 41,000 feet for both model airplanes.

The design of the electronic flight control system for the C-series airplanes incorporates normal load factor limiting on a full time basis that prevents the flightcrew from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. This feature is considered novel and unusual in that the current regulations do not provide standards for maneuverability and controllability evaluations for such systems.

Type Certification Basis

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Bombardier Inc. must show that the C-series airplanes meet the applicable provisions of part 25 as amended by Amendments 25-1 through 25-129 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the C-series airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the C-series airplanes must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36, and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

Novel or Unusual Design Features

The C-series airplanes will use a fly-by-wire electronic flight control system (EFCS). This system provides an electronic interface between the pilot's flight controls and the flight control surfaces for both normal and failure states; and it generates the actual surface commands that provide for stability augmentation and control about all three airplane axes. The design of the EFCS incorporates the following novel or unusual design feature: Normal load factor limiting on a full-time basis that will prevent the flight crew from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. This feature is considered novel or unusual because the current regulations do not provide standards for maneuverability and controllability evaluations for such systems. Therefore, special conditions are needed to ensure adequate maneuverability and controllability when using this design feature.

Discussion

Title 14 Code of Federal Regulations (14 CFR) part 25 sections do not specify requirements or policy for demonstrating maneuver control that impose any handling qualities requirements beyond the design limit structural loads. Nevertheless, some pilots have become

accustomed to the availability of this excess maneuver capacity in case of extreme emergency such as upset recoveries or collision avoidance.

As with previous fly-by-wire airplanes, the FAA has no regulatory or safety reason to prohibit a design for an electronic flight control system with load factor limiting. It is possible that pilots accustomed to this feature feel more freedom in commanding full-stick displacement maneuvers because of the following:

- Knowledge that the limit system will protect the structure,
- Low stick force/displacement gradients,
- Smooth transition from pilot elevator control to limit control.

These special conditions will ensure adequate maneuverability and controllability when using this design feature.

The normal load factor limit on the C-series airplanes is unique in that traditional airplanes with conventional flight control systems (mechanical linkages) are limited in the pitch axis only by the elevator surface area and deflection limit. The elevator control power is normally derived for adequate controllability and maneuverability at the most critical longitudinal pitching moment. The result is that traditional airplanes have a significant portion of the flight envelope wherein maneuverability in excess of limit structural design values is possible.

These proposed special conditions for the C-series airplanes supplement the applicable regulations, including § 25.143, to accommodate the unique features of the flight envelope limiting systems, and establish an equivalent level of safety to the existing regulations.

Applicability

As discussed above, these special conditions are applicable to the Models BD-500-1A10 and BD-500-1A11 series airplanes. Should Bombardier Inc. apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on two model series of airplanes. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Proposed Special Conditions

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for the Bombardier Inc. Models BD-500-1A10 and BD-500-1A11 series airplanes.

1. Flight Envelope Protection: Normal Load Factor (g) Limiting. To meet the intent of adequate maneuverability and controllability required by § 25.143(a), and in addition to the requirements of § 25.143(a) and in the absence of other limiting factors, the following special conditions based on § 25.333(b) apply:

a. The positive limiting load factor must not be less than:

(1) 2.5g for the normal state of the electronic flight control system with the high lift devices retracted.

(2) 2.0g for the normal state of the electronic flight control system with the high lift devices extended.

b. The negative limiting load factor must be equal to or more negative than:

(1) Minus 1.0g for the normal state of the electronic flight control system with the high lift devices retracted.

(2) 0.0g for the normal state of the electronic flight control system with high lift devices extended.

c. Maximum reachable positive load factor wings level may be limited by the characteristics of the electronic flight control system or flight envelope protections (other than load factor protection) provided that:

(1) The required values are readily achievable in turns, and

(2) That wings level pitch up is satisfactory.

d. Maximum achievable negative load factor may be limited by the characteristics of the electronic flight control system or flight envelope protections (other than load factor protection) provided that:

(1) Pitch down responsiveness is satisfactory, and

(2) From level flight, 0g is readily achievable or alternatively, a satisfactory trajectory change is readily achievable at operational speeds. For the FAA to consider a trajectory change as satisfactory, the applicant should propose and justify a pitch rate that provides sufficient maneuvering capability in the most critical scenarios.

e. Compliance demonstration with the above requirements may be performed without ice accretion on the airframe.

These proposed special conditions do not impose an upper bound for the normal load factor limit, nor does it require that the limit exist. If the limit is set at a value beyond the structural design limit maneuvering load factor “n” of §§ 25.333(b) and 25.337(b) and (c), there should be a very obvious positive tactile feel built into the controller so that it serves as a deterrent to inadvertently exceeding the structural limit.

Issued in Renton, Washington, on November 29, 2013.

Jeffrey E. Duven
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Aircraft Certification Service

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